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Creating digital elevation model with Google Earth Pro

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Abstract

The aim of this study is to obtain the Digital Elevation Model (DEM) data, which is needed in many engineering projects, and constitutes the basic data of the projects, in ArcGIS software with the help of Google-Earth Pro software. Mount Ararat, located in the provincial borders of Ağrı and Iğdır, was chosen as the study area and DEM data were created for three different areas. These areas are square areas of 1x1 km, 10x10 km and 100x100 km. The data of the study areas were obtained by converting the data in the Google-Earth Pro software, which was obtained by remote sensing technique, into point format. These data were then converted to *.GPS format and then to *.shp format and DEM data was obtained in ArcGIS software. Consequently, DEM data for an exemplary study area was obtained economically and quickly.

Introduction

Digital Elevation Model (DEM) is a 3D digital graphic representation of the physical earth, including location and height information based on a defined vertical datum (reference). With DEM, the slope of the land, the aspect of the land, drainage networks, basin boundaries, flow paths and relief maps can be made. DEM is used by numerous disciplines that use a geographic basis, including engineering, geomorphology, hydrology, landscape architecture, and archaeology [1-4]. Nowadays DEM is produced from UAV photogrammetry.

In this study, the digital elevation model data, which is needed in many engineering projects and constitutes the basic data of the projects, was obtained in the ArcGIS environment with the help of Google-Earth Pro. In engineering projects, elevation models, which are generally measured by local governments, are preferred because of their sensitivity and accuracy. While these data are generally available within the city limits, they are not available in the regions outside the city limits. For these regions, data obtained by remote sensing methods are generally used because it is faster and more economical. In this study, DEM was obtained for the regions outside the city center. Taurus Mountain was chosen as the study area and DEM data was created.

Material and Method

ArcGIS software and Google Earth Pro software were used in the study. Study area boundaries are square polygons in shapefile (*.shp) format created in the ArcGIS software. 3500 random points were defined in these square polygons. This process was carried out using the "Add Path" icon in the Google Earth Pro software. These points were converted to shape file format and transferred to ArcGIS software and then DEM data were obtained for three areas.

ArcGIS is commercially developed software, but it is also freely available to government agencies and universities/students [5]. With ArcGIS, maps, and imaging, spatial analyzes can be made. In addition to accessing the world's largest collection of imaging, ArcGIS includes tools for satellite imagery, aerial imagery, drone and full motion video [6]. ArcGIS is also generally preferred in solving engineering problems.

Google Earth Pro is a powered version of Google Earth and was made available for free in 2015. Google Earth Pro allows simultaneous mapping of multiple points and accessing demographic and graphical data layers. With Google Earth Pro, advanced measurements can be made on the image, high-resolution printouts can be made, tables, geographic information system files (ESRI shapefile (.shp)) can be created [1]. The fact that the Google Earth Pro program is free and easy to access increases its use for engineering, academic and everyday purposes. Google Earth Pro, together with other Geographic Information System software, contributes to the accessibility, automation, and digital production of geographic information [7-12].

Study Area

Mount Ararat, located in the province of Iğdır-Ağrı, was chosen as the study area and DEM was created for three different sized areas. These areas are square areas of 1x1 km, 10x10 km and 100x100 km. The study area is shown in Figure 1.

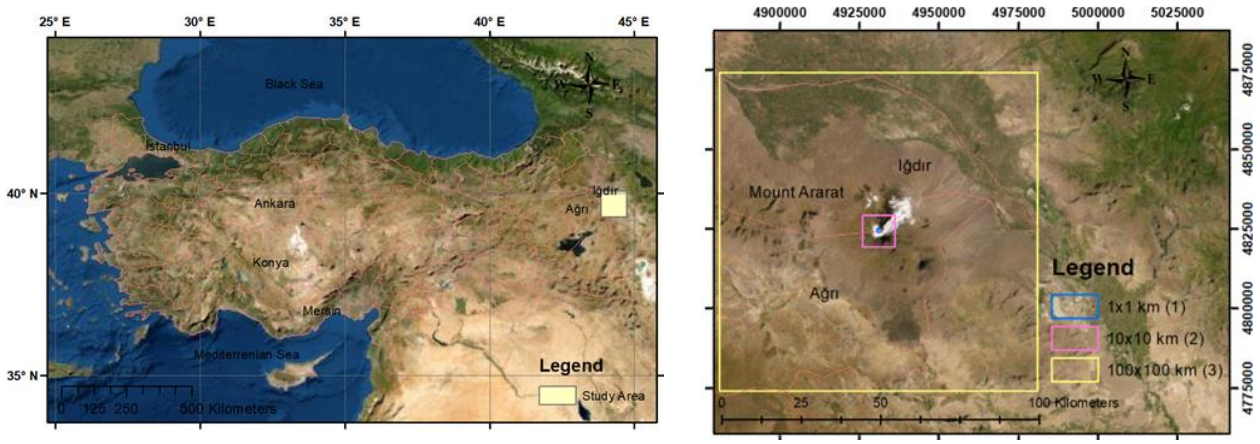

Figure 1. Study area and sample areas

Results

In the application of the study, first, point data obtained from Google Earth Pro was recorded in *.kmz format. Then, GPS data conversion was performed on the web (https://www.gpsvisualizer.com/elevation). Thus, the elevation points have been converted to GPS format. Then, a file in point format was obtained with the Conversion Tools-From GPS-GPX to Features option in ArcGIS software. An elevation map of these points can be obtained by users with the Spatial Analyst Tools-Interpolations option via Arc Toolbox. In addition, Aspect, Contour, Slope or Hillshade maps can be created with the 3D Analyst Tools- Raster Surface option. DEM data from point data was created by defining "Point Elevation" in the Type field in the 3D Analyst Tools- Raster Interpolation- Topo to Raster option. The DEM data obtained by this process are shown in Figure 2 for 3 different sized areas.

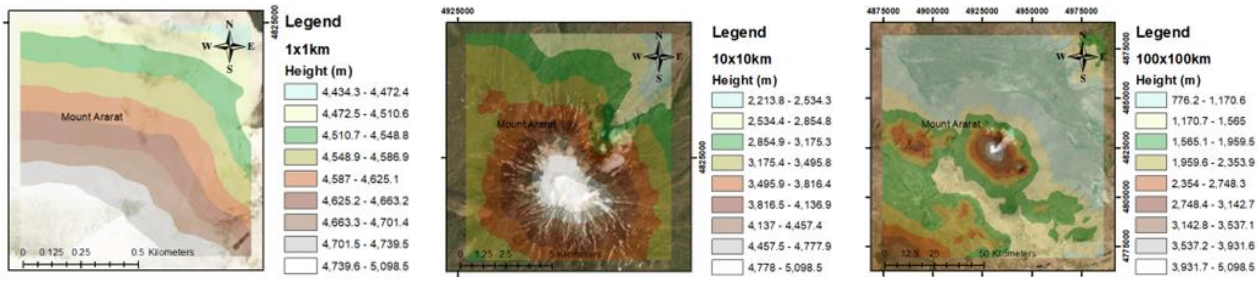

Figure 2. DEM data for three fields

Discussion

DEM accuracy increases with the dot density and the randomness of the dots. However, dense point data is both time-consuming and means more detail than necessary, which causes the computer used to process slower. For this reason, the optimum area and number of points should be determined according to the problem to be studied. In addition, point scans should be determined at a fixed number and fixed height sight level in studies to be compared. In this study, 3500 points were randomly defined. These points are limited as they are the basis for future estimation studies.

Conclusion

In this study, DEM data were obtained in ArcGIS software for three different sized areas. These areas are located around Mount Ararat and are square areas with dimensions of 1x1 km, 10x10 km, and 100x100 km. The data used in the study were provided in Google-Earth Pro software and DEM maps were created in the ArcGIS software. Thus, a sample study has been made for DEM data, which forms the basis of engineering projects. The fact that this data is available especially for areas outside the city limits accelerates engineering projects.

In future studies, the performance comparison of different remote sensing platforms obtained for the same region and the estimation of similar DEM data obtained for different areas will be investigated by machine learning techniques.

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